I – Problem Statement Title (04-GS039)

Develop and Assess Post-Grouting Methods to Increase the Load Capacity of Deep Foundations

II – Research Problem Statement

Question: How can we reduce foundation costs through the use of post-grouting methods to increase the load capacity of deep foundations?

III – Objective

1. Develop guidelines on determining appropriate design parameters and recommended post-grouting specifications
2. Establish the analytical method required to assess the increase in pile capacity due to post-grouting.

IV – Background

Post-grouting techniques have been successfully used to increase pile capacity. However, none of the current analytical methods are capable of reliably evaluating such increase. Analytical methods are required in order to enable the designer to optimize safety factors and thus reduce pile size. Lack of such methods makes post-grouting seem to be an added expense and not a saving factor. The current methods used in predicting the capacity, or more importantly the load-settlement response, of CIDH pile suffer from the uncertainty that develops upon applying many of the differing solutions available for capacity. Worse, the application of an untested hyperbolic load-settlement curve fitted to such potentially different values of "capacity" (not truly an ultimate resistance but one defined by an arbitrary "failure" criterion, e.g. Davisson's) compounds the error. The geotechnical group of the University of Nevada, Reno and the Bridge Research program has developed a so-called "t-z" analysis that is capable of predicting load-settlement response based on a theoretical, rather than empirical, model of soil behavior. The developed method of analysis is particularly useful when it comes to investigating the unload-reload response of piles which occurs during post-grouting application. Accordingly, designers can assess the increase in pile capacity during the design phase of pile shafts. Since the analytical model has already been developed by the UNR group, the objectives will be addressed through experimental methods which in return will assist in verifying and refining the model.

V – Statement of Urgency and Benefits

A. Support of the Department's Mission/Goals:
(Improving Mobility: Safety, Reliability and Productivity) Such goals will be achieved through the successful application of post-grouting. The proposed technique

will act as a pile load test by itself during regular construction activities. This will ensure the reliability of each deep foundation member thus increasing safety factor and/or reducing the number of deep foundations required (reducing overall foundation cost).

B. Return on Investment:

Current Caltrans design procedures and specifications do not consider the potential capacity enhancement due to post-grouting pile shafts. Caltrans typically spends $15M to $20M each year on drilled shaft foundations. Implementing the guidelines from this project will result in reducing the number of pile shafts or CIDH members used, which translates into significant annual savings.

Due to the high cost for constructing and testing CIDH piles, the envisioned test program will augment upcoming drilled shaft projects in California, Nevada and Arizona. There may also be an opportunity to cost share with another proposed pooled-fund project. Combining projects could result is considerable cost savings.

VI – Related Research

As mentioned above, and as acknowledged by Caltrans, the geotechnical team at the University of Nevada, Reno has already developed the backbone model for analyzing piles exposed to loading-unloading-reloading conditions. However, the method suffers from a lack of field test data to confirm its usefulness.

VII – Deployment Potential

Project results would be deployed through enhanced design procedures and specifications.